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Wisconsin Agricultural Experiment Station and other State Experiment Stations, Cooperating

WESTERN REGIONAL SPRING BARLEY NURSERY - 2001 Crop

Preliminary Quality Report

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Contents

This is a joint progress report of cooperative investigations being conducted in the Agricultural Research Service of the U.S. Department of Agriculture and State Agricultural Experiment Stations. It contains preliminary data that have not been sufficiently confirmed to justify general release; interpretations may be modified with additional experimentation. Confirmed results will be published through established channels. The report is primarily a tool available to cooperators and their official staffs and for those persons who have a direct and special interest in the development of improved barleys.

This report includes data furnished by the Agricultural Research Service as well as by the State Agricultural Experiment Stations. The report is not intended for publication and should not be referred to in literature citations nor quoted in publicity or advertising. Use of the data may be granted for certain purposes upon written request to the agency or agencies involved.

Samples malted and analyzed by the Cereal Crops Research Unit, Madison, WI

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Western Regional Spring Barley Nursery – 2001 Crop

Nursery samples were received for malting quality evaluation from three experimental stations located in three states. Fourteen of 22 entries (#9 - #22) were new in this year's nursery (Table 1).

These samples were germinated for 5 days and rotated for 3 minutes every half hour, which should have yielded malts having modification levels that are similar to those produced by industry. The malting conditions and analytical methods employed are listed in Appendix A. The criteria and value assignments used to calculate quality scores are listed in the same Appendix (Table A1).

The mean values for 11 quality factors are listed over the three stations located in the Western Region (Table 2) and over all varieties (Table 3). Individual station data are reported in Tables 4 through 6. The parentages of the nursery entries are listed in Table 1. Evaluations of data from individual locations and overall performance evaluations, derived primarily from Tables 2 and 3, are presented below.

Most of the plump barleys from Aberdeen, ID (Table 4) had unacceptably high protein contents and a quarter of their extract values fell below the desired minimum. A third of the soluble protein values were too low and this, combined with the high total protein contents, resulted in unacceptably low S/T ratios for two thirds of the submissions. The diastatic power values fluctuated considerably, with five values that were too high and fourteen that were too low. Half of the α-amylase and β-glucan levels were too high. The best performers were Lacey, 94AB13449, CDC Bold, CDC Helgason, Foster, 92AB5180, Colter and 97AB8333.

Most of the plump barleys from Fairfield, MT (Table 5) had excellent protein contents and their extract values were generally exceptional, averaging over 81%. Even the feed barleys that were included in this nursery showed good extract levels. Fourteen soluble protein values were too low, but nearly all of those were from feed barleys. Over half of the diastatic power

levels were too low, possibly due to the low total protein levels, while half of the submissions had unacceptably high α-amylase values. Most of the β-glucan levels were high, with 27 exceeding the maximum limit. The best performers were 6B95-2482, CDC Helgason, Drummond, 92AB-5180, 6B95-2089, PB1-97-2R-7090, ND15422, 95SR316A, CDC Copeland and TR167.

A quarter of the barleys from Pullman, WA (Table 6) were too thin, but they had good protein levels. The extract and soluble protein values were very good. Most of the diastatic power and β-glucan levels were good, however all but two of the α-amylase values exceeded the upper limits. The best performers were 6B95-2089, 6B95-2482, 95SR316A, ND15422, Morex, Legacy, 92AB5180 and 2B96-5057.

Overall, the submissions from Fairfield and Pullman (Table 2) performed very well and much better than those from Aberdeen. The barleys from all locations were plump, but those from Fairfield were plumpest. The average protein contents of the barleys from Fairfield were very good, while those from Pullman were mostly good and those from Aberdeen were a bit high. The extract values of the Fairfield malts were exceptional, averaging over 82%, while those from Pullman were very good, at 81.7%, and those from Aberdeen were adequate, at 79.5%. The diastatic power values were best at Pullman, a little bit too low at Fairfield and although the average value at Aberdeen was good, it resulted from many individual values that were either too low or too high. The α-amylase values from all three locations tended to be high, however the Pullman values were higher than those from the other locations. The lines grown at Pullman were well modified, with β-glucan levels averaging 128 ppm, while those from samples grown at the other locations were generally high.

Overall, most of these lines were plump, but their protein contents tended to be a bit high (Table 3), although only three exceeded the upper limits. The extract and soluble protein levels of this year's nursery were generally excellent. Most of the averaged diastatic power values looked good, but only because of locational effects. The low values of the barleys from Fairfield balanced the high values from Pullman, while the results from Aberdeen varied between too high and too low. Three quarters of the α-amylase averages were too high, while the β-glucan levels

ranged from three that were excellent to five that were unacceptably high. The best performers overall were 6B95-2482, 6B95-2089, 92AB5180, 95SR316A, ND15422 and Legacy.

Entries in the Western Regional Spring Barley Nursery - 2001 Crop

Table 1

Entry No.	New Entry	Id	Cultivar or Selection	Rowed	Parentage	Source
1		CI 15773	MOREX	6	Cree/Bonanza	St. Paul, MN
2		PI 564743	STANDER	6	Robust 2*/3/Cree/Bonanza//Manker/4/Robust/Bumper	St. Paul, MN
3		SK 76333	HARRINGTON	2	Klages/3/Gazelle/Betzes//Centenial	Saskatoon, SK
4		OR2967102	BCD 47 (OR2967102)	2	Harrington/Orca//D172(Shyri/Galena)	Corvallis, OR
5		BA6B93-2978	LEGACY (6B93-2978)	6	6B86-3517/Excel	BARI (1)
6		SK-TR150	CDC COPELAND (TR150)	2	WM861-5/TR118	CDC(2)
7		ND15422	ND15422	6	ND9712//ND11646/Stander	Fargo, ND - Horsley
8		ND15477	DRUMMOND (ND15477)	6	ND9712//Stander/ND12200	Fargo, ND - Horsley
9	X	92AB5180	92AB5180	6	83AB5432/SR40	Aberdeen, ID
10	X	WA8682-96	WA8682-96	2	A308/Baronesse	Pullman, WA
11	X	WA10138-96	WA10138-96	2	WA7758-89/Baronesse	Pullman, WA
12	X	6B95-2482	6B95-2482	6	6B89-2126/ND10981	BARI (1)
13	X	6B95-2089	6B95-2089	6	6B84-2912/B1601/6B88-3213	BARI (1)
14	X	2B96-5057	2B96-5057	2	B1215/B88-5336	BARI (1)
15	X	2B97-4077	2B97-4077	2	B1215/2B91-4947	BARI (1)
16	X	2B97-4299	2B97-4299	2	2B91-4947/2B91-4450	BARI (1)
17	X		CDC SELECT	2		CDC(2)
18	X	TR 167	TR 167	2		CDC(2)
19	X	MT960099	MT960099	2	Manley/Baronesse	Bozeman, MT
20	X	MT970116	MT970116	2	Klages/Baronesse	Bozeman, MT
21	X	95SR149C	95SR149C	2	Bancroft/Harrington	Aberdeen, ID
22	X	95SR316A	95SR316A	2	Bancroft/Crystal	Aberdeen, ID

(1) Busch Agricultural Resouces, Inc. - Ft Collins, CO
(2) Canadian Development Center - Saskatoon, SK

WESTERN REGIONAL SPRING BARLEY NURSERY - 2001 Crop

Table 2 - Station Means* of Barley and Malt Quality Factors for 22 Varieties or Selections**.

Location	Barley Kernel Weight (mg)		on 6/64" (%)		Barley Color (Agtron)		Malt Extract (%)		Wort Color	Barley Protein (%)		Wort Protein (%)	S/T (%)		DP (°)		Alpha-amylase (20° DU)		Beta-glucan (ppm)		Ave. Quality Score
Aberdeen, ID	42.5	A	91.6	B	66.1	B	79.5	C	1.79	14.3	C	5.25	38.2	B	134	A	64.7	A	267	B	28.9
Fairfield, MT	41.7	A	97.5	A	78.5	A	82.3	A	1.91	12.0	A	5.12	44.9	A	108	B	65.1	A	298	B	43.0
Pullman, WA	36.1	B	86.1	C	79.3	A	81.7	B	1.74	12.6	B	5.23	43.0	A	133	A	75.4	B	128	A	41.0

* Within each column, means followed by the same letter are not significantly different (alpha=0.05), according to Duncan's Multiple Range test.

** MOREX, STANDER, HARRINGTON, BCD 47, LEGACY, CDC COPELAND, ND15422, DRUMMOND, 92AB5180, WA8682-96, WA10138-96 6B95-2482, 6B95-2089, 2B96-5057, 2B97-4077, 2B97-4299, CDC SELECT, TR 167, MT960099, MT970116, 95SR149C, 95SR316A

WESTERN REGIONAL SPRING BARLEY NURSERY - 2001 Crop

Table 3 - Varietal Means* of Barley and Malt Quality Factors for 3 Stations**.

Variety or Selection	Rowed	Barley Kernel Weight (mg)		on 6/64 (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color		Barley Protein (%)	Wort Protein (%)		S/T (%)		DP (°)		Alpha-amylase (20° DU)		Beta-glucan (ppm)		Ave. Quality Score	Overall Rank
MOREX	6	35.1	EF	84.2	73.7	80.1	1.6	AB	14.0	5.22	EFG	38.8	CDEF	155	ABCDE	58.8	BCD	278	ABCDE	40	7
STANDER	6	36.3	CDEF	91.1	74	81.6	2.0	CDE	12.9	6.06	I	48.9	A	127	BCDEFG	81.0	HIJ	202	ABCD	35	15
HARRINGTON	2	42.0	ABCDE	94.4	74.3	81.9	1.6	AB	13.3	5.56	GH	44.1	ABCD	120	EFGH	70.7	DEFGHI	294	ABCDE	36	13
BCD 47 (OR2967102)	2	44.8	A	94.9	71	79.9	1.8	BCDE	13.8	5.50	G	40.9	BCDE	159	ABC	80.0	GHIJ	230	ABCDE	30	21
LEGACY (6B93-2978)	6	34.3	F	86.0	82	81.1	1.7	ABC	12.4	5.60	GH	48.3	AB	141	ABCDEF	73.5	EFGHI	216	ABCDE	40	6
CDC COPELAND (TR150)	2	44.1	AB	96.2	81.3	81.5	1.6	AB	13.4	5.44	FG	42.6	ABCD	124	BCDEFG	74.3	EFGHI	95	A	37	12
ND15422	6	36.9	BCDEF	95.4	79.7	80.8	1.9	BCDE	13.3	5.48	G	42.9	ABCD	162	AB	65.3	BCDEF	234	ABCDE	41	5
DRUMMOND (ND15477)	6	36.0	DEF	92.9	78.7	80.7	1.7	ABC	13.3	5.28	EFG	41.0	ABCDE	166	A	65.9	BCDEFG	177	ABCD	39	8
92AB5180	6	36.6	CDEF	81.3	67.7	81.7	1.9	BCDE	11.6	5.31	EFG	47.7	AB	131	ABCDEFG	62.4	BCDE	136	AB	45	3
WA8682-96	2	43.5	ABC	96.9	72.3	80.1	1.8	BCDE	12.9	4.54	BC	36.4	DEF	84.7	HI	52.2	AB	416	E	34	18
WA10138-96	2	44.1	AB	95.9	68.3	79.7	2.6	E	12.6	3.94	A	31.9	F	68	I	39.9	A	361	CDE	27	22
6B95-2482	6	35.5	EF	92.3	78	80.7	2.1	DE	13.0	4.98	DE	40.4	BCDE	159	ABCD	58.8	BCD	175	ABCD	48	1
6B95-2089	6	36.6	CDEF	91.5	76	81.4	1.8	ABCD	12.7	5.08	DEF	41.3	ABCDE	130	ABCDEFG	55.3	BC	162	ABC	47	2
2B96-5057	2	41.3	ABCDEF	96.6	75	81.8	1.7	ABC	13.1	5.32	EFG	43.3	ABCD	118	EFGH	72.8	DEFGHI	170	ABCD	38	9
2B97-4077	2	42.1	ABCDE	84.1	70.7	81.3	1.9	BCDE	12.8	5.23	EFG	44.0	ABCD	105	FGH	84.7	IJ	228	ABCDE	34	18
2B97-4299	2	42.2	ABCDE	91.9	72.3	82.5	1.8	ABCD	12.3	5.02	DE	43.9	ABCD	120	DEFGH	78.7	FGHIJ	255	ABCDE	35	16
CDC SELECT	2	39.4	ABCDEF	95.3	78	82.0	1.7	ABC	12.8	5.56	GH	45.0	ABC	123	CDEFGH	84.7	IJ	101	AB	37	10
TR 167	2	40.2	ABCDEF	93.0	73.7	82.0	2.2	D	13.1	5.88	HI	46.5	ABC	126	BCDEFG	91.1	I	92	A	36	14
MT960099	2	41.0	ABCDEF	86.1	70.3	81.0	1.8	BCDE	12.5	5.21	EFG	43.7	ABCD	108	FGH	73.4	EFGHI	295	ABCDE	33	20
MT970116	2	46.0	A	97.5	72	80.7	1.4	A	13.4	4.45	B	34.7	EF	99.7	GHI	52.6	ABC	353	CDE	37	10
95SR149C	2	42.4	ABCDE	90.1	71.5	80.2	1.5	A	13.6	4.78	BCD	36.3	DEF	109	FGH	54.8	BC	381	DE	35	17
95SR316A	2	43.2	ABCDE	91.4	78.7	82.0	1.6	AB	12.8	4.83	CD	39.5	CDE	107	FGH	66.8	CDEFGH	313	BCDE	42	4

* Within each column, means followed by the same letter are not significantly different (alpha=0.05), according to Duncan's Multiple Range test.

** Aberdeen, ID; Fairfield, MT and Pullman, WA

2001 WESTERN REGIONAL SPRING BARLEY NURSERY AND ADDITIONS - ABERDEEN, ID

Table 4

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	Quality Score	Overall Rank
4451	MOREX	6	36.1	82.9	63	77.9	1.6	1	15.2	5.06	35.5	168	56.7	328	27	23
4452	STANDER	6	38.4	92.7	61	80.4	2.1	1	13.8	6.16	46.8	134	74.6	285	34	12
4453	HARRINGTON	2	45.1	98.0	67	79.9	1.6	1	14.9	5.79	40.7	135	67.8	338	31	16
4454	PB1-95-2R-A629	2	48.3	97.1	57	76.2	n.d.	3	15.5	3.70	24.1	77	36.5	671	14	34
4455	PB1-97-2R-7090	2	48.7	96.9	67	80.0	1.6	1	14.2	4.80	34.9	97	55.6	381	30	19
4456	BZ594-20	2	47.7	95.0	65	77.1	1.2	1	13.5	3.85	28.6	81	41.9	444	19	31
4457	BZ596-117	2	48.2	96.8	56	76.6	1.5	2	14.4	3.95	29.1	93	46.4	419	18	32
4458	BCD-47 (OR2967102)	2	47.2	94.4	65	78.7	1.8	1	14.4	5.55	40.0	162	79.3	224	27	23
4459	92AB5180	6	39.4	91.3	57	81.6	2.1	1	11.6	5.43	48.2	119	58.9	214	42	6
4460	WA8682-96	2	46.3	96.2	64	78.2	1.7	2	14.5	4.51	31.1	87	51.9	492	26	25
4461	WA8709-96	2	42.0	89.1	60	75.3	n.d.	3	14.9	3.77	25.7	54	38.2	581	11	36
4462	WA10147-96	2	45.7	97.4	60	76.6	n.d.	3	14.5	3.48	25.6	55	33.3	522	10	37
4463	WA10138-96	2	47.1	97.5	62	77.4	n.d.	3	14.4	3.93	27.5	75	37.5	399	14	34
4464	LEGACY (BA6B93-2978)	6	36.5	91.2	72	79.9	1.8	1	13.7	5.77	43.8	145	67.6	419	39	9
4465	6B95-2482	6	37.5	91.7	70	78.6	n.d.	3	14.4	4.86	35.3	180	54.1	224	31	16
4467	6B95-2089	6	38.9	95.1	60	79.5	1.7	1	14.2	5.38	38.2	140	59.5	223	36	10
4468	2B96-5057	2	44.2	96.7	69	79.6	1.7	1	15.1	5.48	36.2	138	71.8	172	29	20
4469	2B97-4077	2	44.5	*66.0	63	79.3	1.9	1	14.9	5.42	38.6	118	76.5	315	21	30
4470	2B97-4299	2	46.8	96.8	61	80.4	2.0	1	14.4	5.15	37.7	126	70.1	297	32	15
4471	CDC COPELAND (TR150)	2	48.6	98.4	*86	80.4	1.7	1	14.6	5.58	39.6	140	74.4	36	22	28
4472	CDC SELECT	2	41.6	95.2	69	80.8	1.6	1	14.0	5.51	40.6	134	76.8	63	33	13
4473	TR 167	2	43.0	96.4	63	80.7	2.1	1	14.2	6.07	43.6	141	87.0	88	31	16
4474	CDC BOLD	2	46.0	90.8	74	82.1	1.7	1	13.5	5.38	40.6	103	59.6	137	46	3
4475	CDC HELGASON (TR346)	2	42.6	95.1	67	81.0	1.5	1	13.3	4.75	36.5	118	63.6	205	44	4
4476	MT960099	2	42.5	81.8	59	79.6	1.9	1	13.9	5.28	40.4	92	72.0	376	22	28
4477	MT960228	2	43.8	90.1	60	77.4	1.6	2	14.0	3.82	28.5	90	39.3	439	15	33
4478	MT970116	2	49.8	97.3	64	79.5	1.3	1	14.3	4.31	30.6	109	48.5	289	33	13
4479	ND15422	6	38.5	94.4	71	79.1	2.0	1	14.7	5.66	39.0	194	65.2	220	25	26
4480	DRUMMOND (ND15477)	6	38.5	94.4	68	79.1	1.7	1	14.4	5.41	39.4	187	62.0	162	25	26
4481	95SR149C	2	40.9	82.9	69	78.6	1.3	1	14.3	4.53	33.0	103	48.8	386	28	21

Table 4

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	Quality Score	Overall Rank
4483	95SR316A	2	42.7	83.0	71	79.8	1.5	1	14.1	4.67	34.9	115	61.3	317	28	21
4484	COLTER	6	38.6	86.1	65	80.5	1.5	1	11.6	4.08	37.3	107	48.2	297	42	6
4485	FOSTER	6	39.8	94.9	64	79.5	1.8	1	13.0	5.30	42.1	138	58.8	338	44	4
4486	LACEY	6	38.4	93.1	60	80.5	1.6	1	13.4	5.20	40.7	151	57.7	195	53	1
4487	94AB13449	6	38.3	91.5	63	81.8	n.d.	3	11.5	4.96	45.9	112	55.1	147	53	1
4488	96AB10468	6	38.3	89.7	71	80.6	1.8	2	11.5	3.89	36.5	104	44.5	339	35	11
4489	97AB8333	6	35.6	84.9	62	80.7	n.d.	3	11.4	4.54	42.3	94	51.7	476	42	6
4466	HARRINGTON MALT CHECK	2	39.2	94.3	79	81.7	1.7	1	11.7	5.32	48.7	109	70.2	109	43	
4482	HARRINGTON MALT CHECK	2	40.2	94.0	78	81.9	1.7	1	11.3	5.29	48.0	111	72.8	80	48	
Minima			35.6	81.8	56	75.3	1.2		11.4	3.48	24.1	54	33.3	36	10	
Maxima			49.8	98.4	74	82.1	2.1		15.5	6.16	48.2	194	87.0	671	53	
Means			42.6	92.7	64	79.3	1.7		13.9	4.89	36.7	119	58.2	310	30	
Standard Deviations			4.2	4.9	5	1.6	0.2		1.1	0.74	6.1	34	13.5	144	11	
Coefficients of Variation			9.9	5.2	7	2.1	13.9		7.9	15.15	16.7	29	23.2	46	37	

Malt Check Data are Excluded from Rank Sorting and Statistics
Table Data Flagged by an Asterisk Exceed the Mean by +/- 3 Standard Deviations and are Excluded from Statistics
For Wort Clarity - 1 = clear, 2 = slightly hazy, 3 = hazy; Wort Colors were not determined (n.d.) on hazy samples

Samples Submitted by C. Erickson, USDA/ARS - Aberdeen, ID

2001 WESTERN REGIONAL SPRING BARLEY NURSERY - FAIRFIELD, MT

Table 5

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	Quality Score	Overall Rank
4524	STEPTOE	2	45.3	98.3	76	78.0	3.0	3	11.6	3.79	35.5	57	37.1	1048	24	36
4525	BARONESSE	6	44.9	98.4	71	78.1	2.0	2	14.0	3.88	28.8	86	39.1	723	20	39
4526	MOREX	6	37.1	94.6	79	80.8	1.6	1	13.5	5.22	39.9	138	51.9	413	45	11
4527	STANDER	6	37.1	97.1	79	82.7	2.1	1	12.6	6.18	50.7	112	75.2	248	30	32
4528	HARRINGTON	2	43.5	98.4	77	83.7	1.7	1	12.0	5.44	48.6	97	70.4	384	39	20
4529	PB1-95-2R-517	2	44.3	98.4	63	78.5	2.2	2	14.3	4.04	29.4	69	37.5	943	19	40
4530	PB1-95-2R-A629	2	46.5	98.4	65	80.1	3.0	3	13.7	4.13	31.3	80	38.3	855	21	37
4531	PB1-97-2R-7090	2	48.2	99.1	73	82.8	1.9	1	11.8	4.91	43.1	90	53.3	386	48	6
4532	BZ594-20	2	47.0	99.6	68	80.0	1.5	1	12.2	4.26	36.4	81	42.3	498	36	26
4533	BZ596-117	2	47.7	99.1	70	79.7	1.7	1	12.7	4.74	38.4	108	50.5	349	39	20
4534	BCD 47 (OR2967102)	2	46.6	98.6	70	80.7	2.0	1	13.9	5.64	42.5	149	76.5	285	30	32
4535	93AB688	2	39.8	93.3	80	81.9	1.5	1	10.2	3.89	40.7	87	44.7	292	44	14
4536	92AB5180	6	38.4	*90.8	75	82.1	2.0	1	11.4	5.22	48.5	116	56.2	144	50	4
4537	UT 003757	2	41.8	94.8	72	78.6	2.6	3	12.4	3.86	33.3	62	36.1	571	27	35
4538	UT 004467	2	38.7	91.7	75	77.7	2.9	3	11.4	3.99	36.2	57	38.7	461	21	37
4539	UT 95B1216-4087	2	39.2	95.2	79	81.2	1.5	1	10.9	3.63	36.6	54	42.5	576	36	26
4540	UT 97B1480-1632	2	42.0	95.6	68	78.6	1.5	1	12.2	3.91	33.1	77	35.9	646	29	34
4541	WA8682-96	2	44.8	99.1	77	81.3	2.1	2	11.5	4.44	39.0	72	49.1	479	45	11
4542	WA8709-96	2	46.6	98.8	71	80.6	2.1	3	11.5	3.92	35.4	51	38.9	441	31	29
4544	WA10147-96	2	43.7	98.7	70	80.5	2.8	3	10.9	3.60	33.4	45	37.2	507	31	29
4545	WA10138-96	2	46.0	98.8	69	80.9	3.0	3	11.6	4.06	35.2	61	37.6	453	31	29
4546	LEGACY (6B93-2978)	6	35.9	96.3	88	82.4	1.9	1	10.9	5.60	55.4	114	73.2	163	38	23
4547	6B95-2482	6	36.6	98.0	84	81.5	2.6	3	12.3	5.04	43.2	141	53.6	225	59	1
4548	6B95-2089	6	37.0	95.4	85	82.6	2.0	2	11.5	4.93	43.8	101	43.2	196	50	4
4549	2B96-5057	2	42.1	98.7	79	83.5	1.8	1	11.2	5.09	49.5	93	68.4	232	42	17
4550	2B97-4077	2	44.4	97.7	72	82.7	2.0	1	11.8	5.12	47.3	85	78.4	254	38	23
4551	2B97-4299	2	44.6	98.9	76	84.2	1.9	1	10.1	4.78	50.2	86	71.9	314	39	20
4552	CDC COPELAND (TR150)	2	44.1	98.3	80	82.5	1.5	1	12.3	5.21	44.2	105	67.5	177	47	9
4553	CDC SELECT	2	40.8	98.9	81	83.1	1.6	1	11.8	5.42	47.0	112	82.1	183	44	14
4554	TR 167	2	42.4	99.4	78	83.6	2.3	1	11.5	5.64	51.3	107	92.3	118	46	10

Table 5

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	Quality Score	Overall Rank
4555	CDC BOLD	2	37.2	95.8	84	84.1	1.9	1	11.0	5.15	50.2	105	77.9	305	34	28
4556	CDC HELGASON (TR346)	2	43.0	99.2	78	82.6	1.9	1	12.4	4.97	40.4	113	69.9	368	51	2
4557	MT960099	2	44.1	96.5	73	82.5	1.7	1	11.3	4.76	45.1	90	75.7	373	44	14
4558	MT960228	2	45.5	98.4	78	81.0	2.0	2	11.2	3.91	36.2	89	42.6	634	38	23
4559	MT970116	2	45.9	98.6	76	81.3	1.5	1	12.9	4.47	37.3	96	53.2	510	42	17
4560	ND15422	6	38.9	97.5	88	81.9	1.8	1	12.3	5.22	44.5	139	61.8	372	48	6
4561	DRUMMOND (ND15477)	6	37.2	97.9	87	81.8	1.6	1	12.4	5.18	42.1	141	64.4	303	51	2
4562	95SR149C	2	43.8	97.3	74	81.7	1.6	1	12.9	5.03	39.6	115	60.7	376	41	19
4563	95SR316A	2	46.1	98.9	80	82.8	1.8	1	12.3	5.00	41.8	105	69.6	352	48	6
4564	MERIT	2	43.0	97.3	75	83.2	2.0	1	12.1	5.45	48.7	122	89.8	279	45	11
4543	HARRINGTON MALT CHECK	2	39.3	94.2	82	81.9	1.9	1	12.3	5.57	48.5	98	69.5	129	43	
4565	HARRINGTON MALT CHECK	2	40.0	93.5	83	81.7	1.7	1	12.0	5.36	47.0	103	75.3	116	43	
Minima			35.9	91.7	63	77.7	1.5		10.1	3.60	28.8	45	35.9	118	19	
Maxima			48.2	99.6	88	84.2	3.0		14.3	6.18	55.4	149	92.3	1048	59	
Means			42.5	97.6	76	81.4	2.0		12.0	4.72	41.3	95	57.1	411	39	
Standard Deviations			3.6	1.8	6	1.8	0.5		1.0	0.68	6.6	27	16.9	212	10	
Coefficients of Variation			8.5	1.9	8	2.2	22.8		8.1	14.32	16.1	28	29.6	52	25	

Malt Check Data are Excluded from Rank Sorting and Statistics
Table Data Flagged by an Asterisk Exceed the Mean by +/- 3 Standard Deviations and are Excluded from Statistics
For Wort Clarity - 1 = clear, 2 = slightly hazy, 3 = hazy; Wort Colors were not determined (n.d.) on hazy samples

Samples Submitted by S. Henderson, BARI - Ft. Collins, CO

2001 WESTERN REGIONAL SPRING BARLEY NURSERY AND ADDITIONS - PULLMAN, WA

Table 6

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	Quality Score	Overall Rank
4566	STANDER	6	33.4	83.4	82	81.7	1.9	1	12.4	5.83	49.3	135	93.1	72	42	9
4567	6B95-2089	6	33.8	84.1	83	82.2	1.6	1	12.5	4.93	42.0	149	63.2	66	54	1
4568	WA 10138-96	2	39.3	91.5	74	80.9	2.5	2	11.9	3.83	33.1	68	44.6	232	35	16
4569	BCD 47	2	40.5	91.6	78	80.4	1.7	1	13.2	5.30	40.1	167	84.2	181	34	18
4570	CDC SELECT	2	35.9	91.9	84	82.0	1.8	1	12.5	5.75	47.3	122	95.2	56	35	16
4571	2B97-4077	2	37.4	88.6	77	82.0	1.8	1	11.8	5.14	46.1	112	99.2	116	42	9
4572	MOREX	6	32.2	75.0	79	81.5	1.6	1	13.2	5.39	41.0	160	67.9	93	47	5
4573	LEGACY	6	30.4	70.6	86	81.0	1.5	1	12.5	5.42	45.7	163	79.8	65	44	6
4574	DRUMMOND	6	32.2	86.5	81	81.2	1.7	1	13.1	5.26	41.6	171	71.3	66	42	9
4575	6B95-2482	6	32.5	87.2	80	82.0	1.8	1	12.2	5.03	42.6	155	68.7	75	54	1
4576	92AB5180	6	32.1	61.8	71	81.5	1.7	1	11.9	5.27	46.4	158	72.1	50	44	6
4577	2B97-4299	2	35.2	80.1	80	82.9	1.4	1	12.4	5.13	43.7	149	94.2	153	33	20
4578	CDC COPELAND	2	39.6	92.0	78	81.7	1.7	1	13.2	5.53	43.9	126	80.9	73	42	9
4579	FARMINGTON	2	34.7	82.6	69	81.5	*2.9	2	13.0	4.56	37.9	126	48.1	268	40	13
4580	95SR316A	2	40.7	92.4	85	83.3	1.6	1	11.9	4.81	41.7	100	69.6	270	50	3
4581	MT970116	2	42.4	96.5	76	81.4	1.4	1	12.9	4.58	36.3	94	56.2	261	37	15
4582	2B96-5057	2	37.7	94.3	77	82.3	1.7	1	12.9	5.38	44.2	123	78.3	105	44	6
4583	MT960099	2	36.5	80.1	79	81.0	1.9	1	12.4	5.60	45.6	142	72.6	136	34	18
4584	ND 15422	6	33.4	94.2	80	81.4	1.8	1	12.8	5.55	45.3	152	68.9	110	49	4
4585	WA 8682-96	2	39.4	95.3	76	80.7	1.7	2	12.6	4.66	39.0	95	55.7	276	30	21
4586	HARRINGTON	2	37.4	86.9	79	82.2	1.6	1	13.0	5.44	43.0	128	74.0	160	38	14
4587	TR 167	2	35.1	83.1	80	81.8	2.1	1	13.5	5.93	44.6	129	94.0	71	30	21
4589	MOREX MALT CHECK	6	31.3	70.8	75	80.4	2.0	1	13.0	6.15	51.0	122	72.9	76	27	
Minima			30.4	61.8	69	80.4	1.4		11.8	3.83	33.1	68	44.6	50	30	
Maxima			42.4	96.5	86	83.3	2.5		13.5	5.93	49.3	171	99.2	276	54	
Means			36.0	85.9	79	81.7	1.7		12.6	5.20	42.7	133	74.2	134	41	
Standard Deviations			3.3	8.6	4	0.7	0.2		0.5	0.49	3.8	27	15.3	79	7	
Coefficients of Variation			9.3	10.0	5	0.8	13.8		3.9	9.42	8.9	20	20.6	59	17	

Malt Check Data are Excluded from Rank Sorting and Statistics

Table Data Flagged by an Asterisk Exceed the Mean by +/- 3 Standard Deviations and are Excluded from Statistics

For Wort Clarity - 1 = clear, 2 = slightly hazy, 3 = hazy; Wort Colors were not determined (n.d.) on hazy samples

Samples Submitted by S. Ullrich, Washington State University - Pullman

Table A1 2001 Crop Year

Quality Score Parameters for 2- and 6-rowed barleys

	2-rowed		6-rowed	
Quality parameter	condition	score	condition	score
Kernel Weight	> 42.0	5	> 32.0	5
(mg)	40.1–42.0	4	30.1–32.0	4
	38.1–40.0	2	28.1–30.0	2
	≤ 38.0	0	≤ 28.0	0
on 6/64 "	≥ 90.0	5	≥ 77.0	5
(%)	85.0–89.9	3	70.0–76.9	3
	< 85.0	0	< 70.0	0
Malt Extract	≥ 81.0	10	≥ 80.0	10
(% db)	79.5–80.9	7	79.0–79.9	7
	78.0–79.4	4	78.0–78.9	4
	<78.0	0	< 78.0	0
Wort Clarity	= 3	0	= 3	0
3=hazy	= 2	1	= 2	1
2=slightly hazy	= 1	2	= 1	2
1=clear				
Barley Protein	≥ 13.5	0	≥ 14.0	0
(% db)	12.6–13.4	5	12.6–13.9	5
	10.1–12.5	10	10.6–12.5	10
	≤ 10.0	5	≤ 10.5	5
Wort Protein	> 6.0	0	> 6.0	0
(% db)	5.1–6.0	3	5.3–6.0	3
	4.4–5.0	7	4.6–5.2	7
	< 4.4	0	< 4.6	0
S/T (Soluble/Total	> 46.0	0	> 46.0	0
Protein, % db)	40.0–46.0	5	40.0–46.0	5
	< 40.0	0	< 40.0	0
DP (Diastatic	> 140.0	0	> 170.0	0
Power, ° ASBC)	130.1–140.0	4	160.1–170.0	4
	110.0–130.0	7	140.0–160.0	7
	95.0–109.9	4	130.0–139.9	4
	< 95.0	0	< 130.0	0
Alpha-amylase	> 55.0	0	> 60.0	0
(20° DU)	50.1–55.0	4	55.1–60.0	4
	40.0–50.0	7	45.0–55.0	7
	35.0–39.9	4	40.0–44.9	4
	< 35.0	0	< 40.0	0
Beta-glucan	< 40	0	< 40	0
(ppm)	40 –80	3	40 –80	3
	80 – 150	7	80 – 150	7
	150 – 300	3	150 – 300	3
	> 300	0	> 300	0

Appendix A: METHODS

Cleaning All samples were cleaned on a Carter Dockage Tester and any material not retained on a 5/64" screen was discarded.

Barley Mill Ground barley was prepared with a Labconco Burr mill that was adjusted so that only 35% of the grist remained on a 525 µm sieve after 3 min of shaking and tapping.

Kernel Weight The number of kernels in a 20 g aliquot of each sample was counted electronically and the '1000 kernel weight' was calculated.

Plumpness Samples were sized on a Eureka-Niagra Barley Grader and the percentage of the seeds retained on a 6/64" screen was determined.

Barley Color The brightness of the grains was measured using an Agtron M31A analyzer.

Barley Moisture Content Five g of ground sample was dried for 3 h at 106°C. The percentage of weight loss that occurred during this drying was calculated.

Barley Protein Content Total nitrogen values were obtained using an automated Dumas combustion procedure with a LECO FP-528 analyzer. Nitrogen values were converted to protein percentages by multiplication by 6.25.

Malting Conditions 170 g (db) barley samples were steeped at 16°C for 32-48 h, to 45% moisture, by alternating 4 h of wet steep with 4 h of air rest. The steeped samples were placed in a chamber for 5 d at 17°C and near 100% R.H., in cans which were rotated for 3.0 min every 30 min. The germinated grain (green malt) was kilned for 24 h as follows: 0.5 h from 25 C to 49°C, 9.5 h at 49°C, 0.5 h from 49°C to 54°C, 4.0 h at 54°C, 0.5 h from 54°C to 60°C, 3.0 h at 60°C, 0.5 h from 60°C to 68°C, 2.0 h at 68°C, 0.5h from 68°C to 85°C, and 3.0 h at 85°C.

Malt Mill Fine-grind malts were prepared with a Miag laboratory cone mill that was adjusted so that 10% of the grist remained on a 525 µm sieve after 3 min of shaking, with tapping. Coarse-grind malts were prepared with a corrugated roll mill that was adjusted so that 75% of the grist remained on a 525 µm sieve. Ground malts for moisture, protein and amylolytic activity analyses were ground in a Labconco Burr mill (see Barley Mill).

Malt Moisture Content See Barley Moisture Content.

Malt Protein Content See Barley Protein Content.

Malt Extract The finely ground samples were extracted using the Malt-4 procedure (Methods of Analysis of the ASBC, 8th ed, 1992), except that all weights and volumes specified for the method were halved. The specific gravity of the filtrate was measured with an Anton/Parr DMA5000 density meter. The density data were used to calculate the amount of soluble material present in the filtrate, and thus the percentage that was extracted from the malt.

Wort Color was determined on a Skalar SAN plus analyzer by subtracting the absorbance at 700 nm from that at 430nm and dividing by a factor that was determined by comparison with values obtained in a collaborative test.

Wort Clarity was assessed by visual inspection.

b-Glucan Levels were determined on a Skalar SAN plus analyzer by using the Wort-18 fluorescence flow injection analysis method with calcofluor as the fluorescent agent (Methods of Analysis of the ASBC, 8th ed, 1992).

Soluble (Wort) Protein Levels were determined on a Skalar SAN plus analyzer using the Wort-17 UV-spectrophotometric method (Methods of Analysis of the ASBC, 8th ed, 1992).

S/T Ratio was calculated as Soluble Protein / Total Malt Protein

Diastatic Power Values were determined on a Skalar SAN plus analyzer by the automated ferricyanide procedure Malt-6A (Methods of Analysis of the ASBC, 8th ed, 1992).

a-Amylase activities were measured on a Skalar SAN plus analyzer by heating the extract to 73°C to inactivate any β-amylase present. The remaining (α-amylase) activity was measured as described for Diastatic Power Values.

Quality Scores were calculated by using a modification of the method of Clancy and Ullrich (Cereal Chem. 65:428-430, 1988). The criteria used to quantify individual quality factors are listed in Table A1.

Overall Rank Values were ordered from low to high based on their Quality Scores. A rank of '1' was assigned to the sample with the best quality score.